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DATA SHEET

TZA1015

Data amplifier and laser supply circuit for CD and read-only optical systems (HDALAS)

Product specification
Supersedes data of 1998 Sep 09
File under Integrated Circuits, IC01

1999 Aug 19

Philips
Semiconductors

PHILIPS

Data amplifier and laser supply circuit for CD and read-only optical systems (HDALAS)

TZA1015

FEATURES

- Six input buffer amplifiers with low-pass filtering and virtually no offset
- Universal photodiode IC interface using internal conversion resistors
- RF data amplifier with wide bandwidth designed for data rates up to a maximum of 30×
- Programmable RF gain for CD-A/V, CD-R, CD-R/W and CD-ROM applications
- Programmable RF bandwidth for optimal playability
- Radial error signal for fast track counting
- Programmable RF/Fast Track Count (FTC) gain for optimal dynamic range
- Fully automatic laser control including stabilization and on/off switch plus a separate supply for power efficiency
- Automatic monitor diode polarity selection
- Adjustable laser bandwidth and laser switch-on current slope using external capacitor
- Protection circuit to prevent laser damage due to supply voltage dip
- Optimized interconnection between data amplifier and Philips' digital signal processor family (CD7, ACE and MACE)
- Wide supply voltage range
- Wide temperature range
- Low power consumption.

GENERAL DESCRIPTION

The TZA1015 is a data amplifier and laser supply circuit for 3-beam pick-up detectors found in a wide range of CD and read-only optical systems.
The device contains 6 transimpedance amplifiers to amplify and filter the focus and radial photo diode voltage input signals. The preamplifier forms a versatile, programmable interface from voltage output CD mechanisms to the Philips' digital signal processor family.

The dynamic range of this preamplifier/processor combination can be optimized for the LF servo and RF data paths. The servo channel gain is set by the ADC range of the processor. The RF data channel can be programmed in the TZA1015 preamplifier.
The programmable RF bandwidth allows this device to be used in CD-A/V applications or CD-R, CD-R/W and CD-ROM applications with a data rate up to a maximum of 30×. The RF and LF gain can be adapted for CD-A/V, CD-R and CD-ROM discs or CD-R/W discs by means of a gain switch. In addition to this gain switch the RF gain is programmable to guarantee optimal playability. In order to enable minimal access time the TZA1015 generates a Fast Track Count signal which enables the decoder (ACE or MACE) to count the number of tracks during a track jump.

The device can accommodate astigmatic, single Foucault and double Foucault detectors and can be used with all laser and N- or P-sub monitor diodes. The Automatic Laser Power Control (ALPC) circuit will maintain control over the laser diode current. With an on-chip reference voltage generator, a constant and stabilized output power is ensured independent of ageing. A separate power supply connection allows the internal power dissipation to be reduced by connecting a low voltage supply.

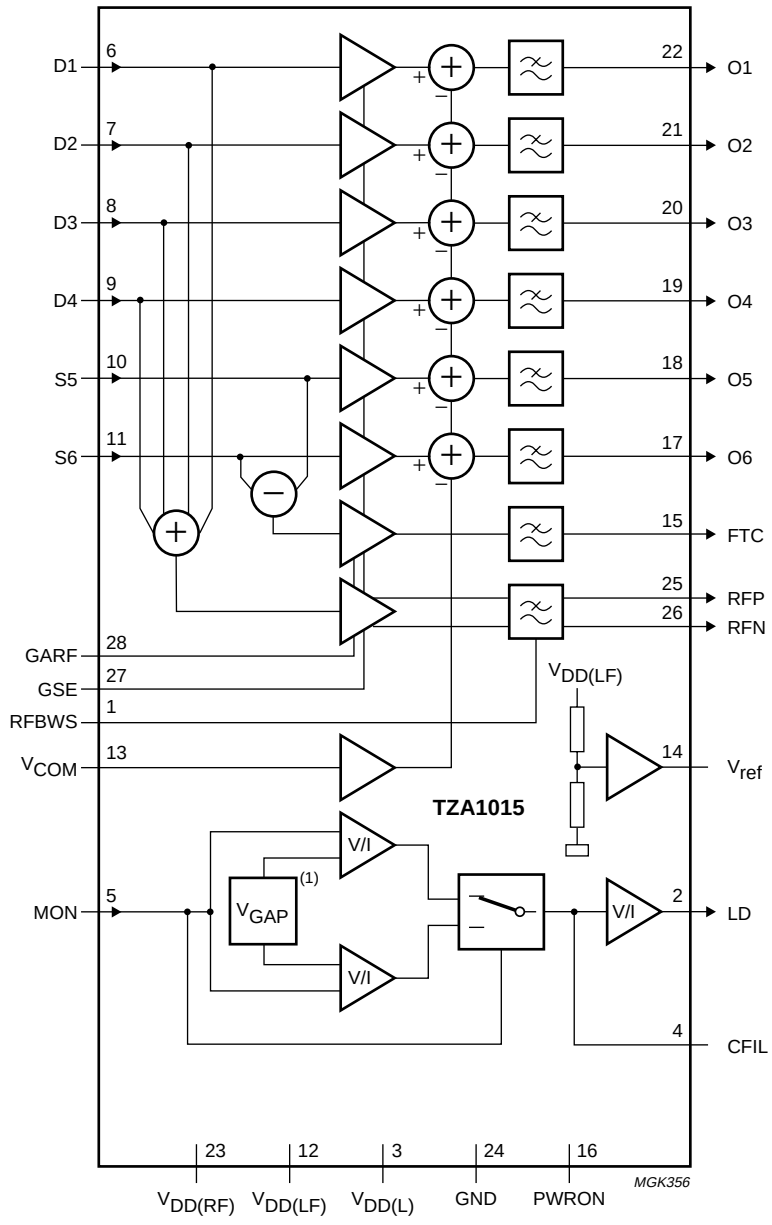
ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TZA1015T	SO28	plastic small outline package; 28 leads; body width 7.5 mm	SOT136-1

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
$V_{DD(RF,LF)}$	supply voltage		4.5	5.0	5.5	V
$V_{DD(L)}$	laser supply voltage		3	–	5.5	V
LF amplifiers						
I_{OS}	channel matching		–	–	1	%FS
$B_{(-3dB)}$	−3 dB bandwidth		65	90	115	kHz
RF amplifier						
$B_{(-3dB)}$	−3 dB bandwidth	programmable; GARF = open-circuit	–	10	–	MHz
			–	20	–	MHz
			–	50	–	MHz
$t_{d(f)(RF)}$	RF flatness delay		–	–	0.4	ns
Laser supply						
$I_{o(LASER)(min)}$	minimum laser output current	$V_{DD(L)}$ = 3 V	–	–	100	mA
$V_{i(mon)}$	monitor input voltage					
	N-type monitor		–	0.150	–	V
	P-type monitor		–	$V_{DD(RF,LF)}$ − 0.150	–	V
Temperature range						
T_{oper}	operating temperature		0	–	85	°C
T_{stg}	storage temperature		−65	–	+150	°C

BLOCK DIAGRAM



(1) Bandgap reference voltage.

Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
RFBWS	1	RF amplifier bandwidth select
LD	2	current output to the laser diode
$V_{DD(L)}$	3	laser supply voltage
CFIL	4	external filter capacitor
MON	5	laser monitor diode input
D1	6	input photo diode amplifier 1 (central)
D2	7	input photo diode amplifier 2 (central)
D3	8	input photo diode amplifier 3 (central)
D4	9	input photo diode amplifier 4 (central)
S5	10	input photo diode amplifier 5 (satellite)
S6	11	input photo diode amplifier 6 (satellite)
$V_{DD(LF)}$	12	LF diode and FTC amplifier supply voltage
V_{COM}	13	common mode DC reference input
V_{ref}	14	DC reference voltage for biasing of Opto Electronic IC (OEIC)
FTC	15	fast track count amplifier output
PWRON	16	power on/off switch (V_{ref} bias generator always active)
O6	17	output photo diode amplifier 6
O5	18	output photo diode amplifier 5
O4	19	output photo diode amplifier 4
O3	20	output photo diode amplifier 3
O2	21	output photo diode amplifier 2
O1	22	output photo diode amplifier 1
$V_{DD(RF)}$	23	RF amplifier supply voltage
GND	24	ground
RFP	25	positive output RF data amplifier
RFN	26	negative output RF data amplifier
GSE	27	gain select for CD, CD-R, CD-R/W; RF and FTC amplifiers
GARF	28	gain adjust for RF and FTC amplifiers

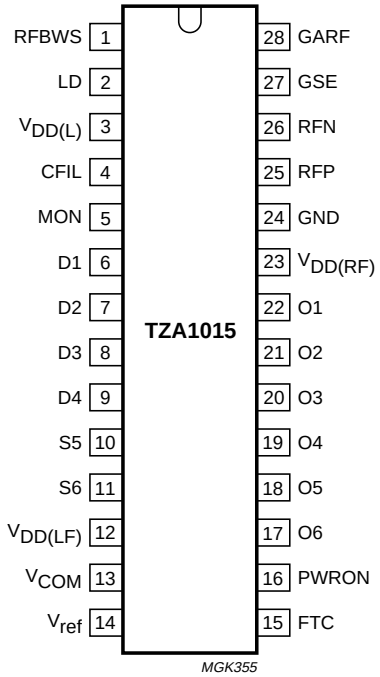


Fig.2 Pin configuration.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{DD(RF,LF)}$	supply voltage		–0.5	+5.5	V
$V_{I(n)}$	input voltage for all pins		–0.5	$V_{DD(RF,LF)}$ + 0.5	V
I_{source}	source current				
	pin FTC		–	4	mA
	pin RFP		–	2	mA
	pin RFN		–	2	mA
T_{amb}	operating ambient temperature		–40	+100	°C
P_{max}	maximum power dissipation	note 1	–	700	mW

Note

1. Based on standard measurement for determining thermal resistance of the package. In accordance with MIL-STD 883C.

CHARACTERISTICS

$V_{DD(LF)} = V_{DD(RF)} = V_{DD(L)} = 5.0$ V; $T_{amb} = 25$ °C; PWRON = HIGH; GSE = LOW; GARF = open-circuit; RFBWS = HIGH; DC input voltages at pins V_{COM}, D1 to D4, S5 and S6 = $\frac{1}{2}V_{DD}$; output voltage at pins O1 to O6 = 0 V; $I_{DD(L)(d)} = 50$ mA; $C_{CFIL} = 1$ nF; unless otherwise specified. Diode input voltages all with respect to V_{COM}.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
$V_{DD(RF,LF)}$	supply voltage		4.5	5.0	5.5	V
$V_{DD(L)}$	laser supply voltage		3	–	5.5	V
$I_{DD(LF)}$	LF supply current		–	13	–	mA
$I_{DD(RF)}$	RF supply current		–	20	–	mA
$I_{DD(L)(d)}$	laser diode supply current		–	50	100	mA
I_q	quiescent supply current	PWRON = LOW	–	–	6	mA
Input voltages						
$V_{i(D1\text{-}D4,S5,S6)}$	input signal voltage range (with respect to V_{COM})	all inputs; GSE = LOW	0	–	0.6	V
		all inputs; GSE = HIGH	0	–	0.15	V
$V_{I(CM)}$	common mode DC reference input voltage range		1.6	–	$V_{DD(RF,LF)}$ – 2.2	V

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
LF diode amplifiers						
Z_{CONV}	conversion impedance					
	central diodes, D1 to D4	GSE = LOW	40	47	54	kΩ
		GSE = HIGH	10.5	12.5	15.0	kΩ
	satellite diodes, S5 and S6	GSE = LOW	75	92	106	kΩ
		GSE = HIGH	20.5	24.5	28	kΩ
$I_{o(LF)}$	output current range	note 1				
	central diodes, O1 to O4		0	–	12	μA
	satellite diodes, O5 and O6		0	–	6	μA
$V_{O(LF)}$	DC output voltage range central and satellite diodes		–0.2	–	$V_{DD(RF,LF)}$ – 2.1	V
Z_i	input impedance					
	central diodes		–	3.1	–	pF
	satellite diodes		–	3.1	–	pF
I_{OS}	channel pair matching	note 2				
	central diodes, O1 to O4		–1	–	+1	%FS
	satellite diodes, O5 and O6		–2	–	+2	%FS
$B_{(-3dB)}$	–3 dB bandwidth					
	central diodes, D1 to D4		65	90	115	kHz
	satellite diodes, S5 and S6		65	90	115	kHz
RF amplifier						
$V_{O(RFP)}$	DC output level RFP	GSE = LOW or HIGH; $V_{i(D1\ to\ D4)}$ = 0 V	0.25	0.5	0.7	V
$V_{O(RFN)}$	DC output level RFN	GSE = LOW or HIGH; $V_{i(D1\ to\ D4)}$ = 0 V	2.6	3.1	3.4	V
$V_{o(RF)(dif)}$	differential RF output signal ($V_{o(RFP)} - V_{o(RFN)}$)	note 3	–	2	–	V
$V_{o(RF)}$	single-sided RF output signal	note 3	–	1	–	V
$Z_{o(RF)}$	RF output impedance		–	25	–	Ω

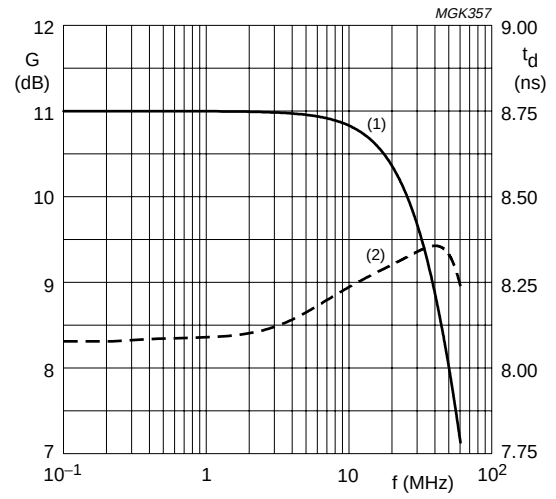
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
G_{RF}	RF path gain	note 4				
		GSE = LOW	9	10.5	12	dB
		GSE = HIGH	21	22.5	24	dB
$t_{d(f)(RF)}$	RF flatness delay	GSE = LOW or HIGH; note 5				
		f < 5 MHz; RFBWS = LOW	–	–	2.0	ns
		f < 10 MHz; RFBWS = open-circuit	–	–	1.0	ns
		f < 25 MHz; RFBWS = HIGH	–	–	0.4	ns
$B_{RF(-3dB)}$	−3 dB bandwidth (RF signal)	GSE = LOW or HIGH				
		RFBWS = LOW	–	10	–	MHz
		RFBWS = open-circuit	–	20	–	MHz
		RFBWS = HIGH	–	50	–	MHz
$V_{n(in\text{-}band)(rms)}$	in-band noise (RMS value)	RFBWS = LOW	–	1.0	–	mV
		RFBWS = open-circuit	–	1.4	–	mV
		RFBWS = HIGH	–	2.1	–	mV
$V_{O(FTC)}$	fast track count DC output level	GSE = LOW or HIGH; note 6	1.3	1.5	1.7	V
G_{FTC}	fast track count gain	f = 100 kHz; note 7				
		GSE = LOW	16.5	18	19.5	dB
		GSE = HIGH	26.5	28	29.5	dB
$B_{FTC(-3dB)}$	fast track count −3 dB bandwidth		220	300	380	kHz
Laser supply (APC)						
$I_{o(LASER)(min)}$	minimum laser output current		–	–	100	mA
$V_{i(mon)}$	monitor input voltage					
	N-type		−10%	0.150	+13.5%	V
	P-type		–	$V_{DD(RF,LF)}$ − 0.150	–	V
$V_{o(LASER)}$	laser output voltage range	$I_{o(LASER)}$ = 100 mA	–	–	$V_{DD(L)}$ − 1.2	V
$t_{sw(on)(LASER)}$	laser switch-on time		–	3	–	ms
$I_{i(mon)}$	monitor input current		–	–	100	nA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Control inputs						
$Z_{i(pd)}$	pull-down input impedance (pin GSE)		–	150	–	kΩ
$Z_{i(pu)}$	pull-up input impedance (pin PWRON)		–	150	–	kΩ
V_{IL}	LOW-level input voltage					
	pins GSE and PWRON		–0.2	–	$\frac{V_{DD(RF,LF)}}{3.3}$	V
	pins GARF and RFBWS		–0.2	–	+0.5	V
V_{IH}	HIGH-level input voltage					
	pins GSE and PWRON		$\frac{V_{DD(RF,LF)}}{1.4}$	–	$V_{DD(RF,LF)}$ + 0.2	V
	pins GARF and RFBWS		$V_{DD(RF,LF)}$ – 0.5	–	$V_{DD(RF,LF)}$ + 0.2	V
I_{IL}	LOW-level input current (pins GARF and RFBWS)		–	–	–70	µA
I_{IH}	HIGH-level input current (pins GARF and RFBWS)		–	–	80	µA
V_{ref} voltage source						
V_O	DC output voltage		–10%	$\frac{V_{DD(RF,LF)}}{2}$	+10%	V
I_O	output current range					
	sink		1.5	–	–	mA
	source		–	–	–3	mA
Z_O	DC output impedance		–	–	30	Ω

Notes

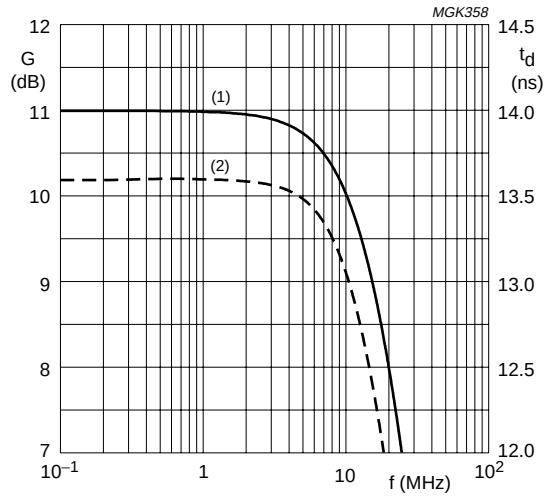
1. The output current can be increased but does not match the default input range of the servo system.
2. Matching defined in % of FS output per channel pairs (O1 – O2), (O3 – O4), (S5 – S6), at $\frac{1}{3}$ and $\frac{2}{3}$ of full output scale.
3. $V_{o(RFP)} = V_{o(RF)}$; $V_{o(RFN)} = -V_{o(RF)}$.
4. Gain is defined as: $G_{RF} = 20 \times \log\left[\frac{V_{o(RFP)}}{V_{i(LF)}}\right] = 20 \times \log\left[\frac{V_{o(RFN)}}{V_{i(LF)}}\right]$

   All inputs assumed to be equal: $V_{i(LF)} = \frac{\Sigma V_{i(D)}}{4}$, where i = 1 to 4 and D means diode.
5. See Figs 3, 4 and 5.
6. Voltage is based on 2 PN junctions and is temperature dependent.
7. Gain is defined as: $G_{FTC} = 20 \times \log\left[\frac{V_{o(FTC)}}{(V_{i(S5)} - V_{i(S6)})}\right]$



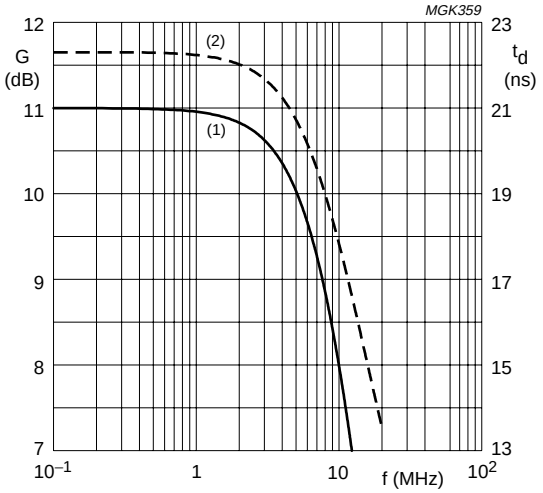
(1) Gain.
(2) Delay. Definition of delay: $\text{delay} = \frac{\left(\frac{\varphi}{360}\right)}{f}$

Fig.3 Gain and delay for 50 MHz bandwidth.



(1) Gain.
(2) Delay. Definition of delay: $\text{delay} = \frac{\left(\frac{\varphi}{360}\right)}{f}$

Fig.4 Gain and delay for 20 MHz bandwidth.



(1) Gain.
(2) Delay. Definition of delay: $\text{delay} = \frac{\left(\frac{\varphi}{360}\right)}{f}$

Fig.5 Gain and delay for 10 MHz bandwidth.

Table 1 Control inputs, conversion impedances and gain settings

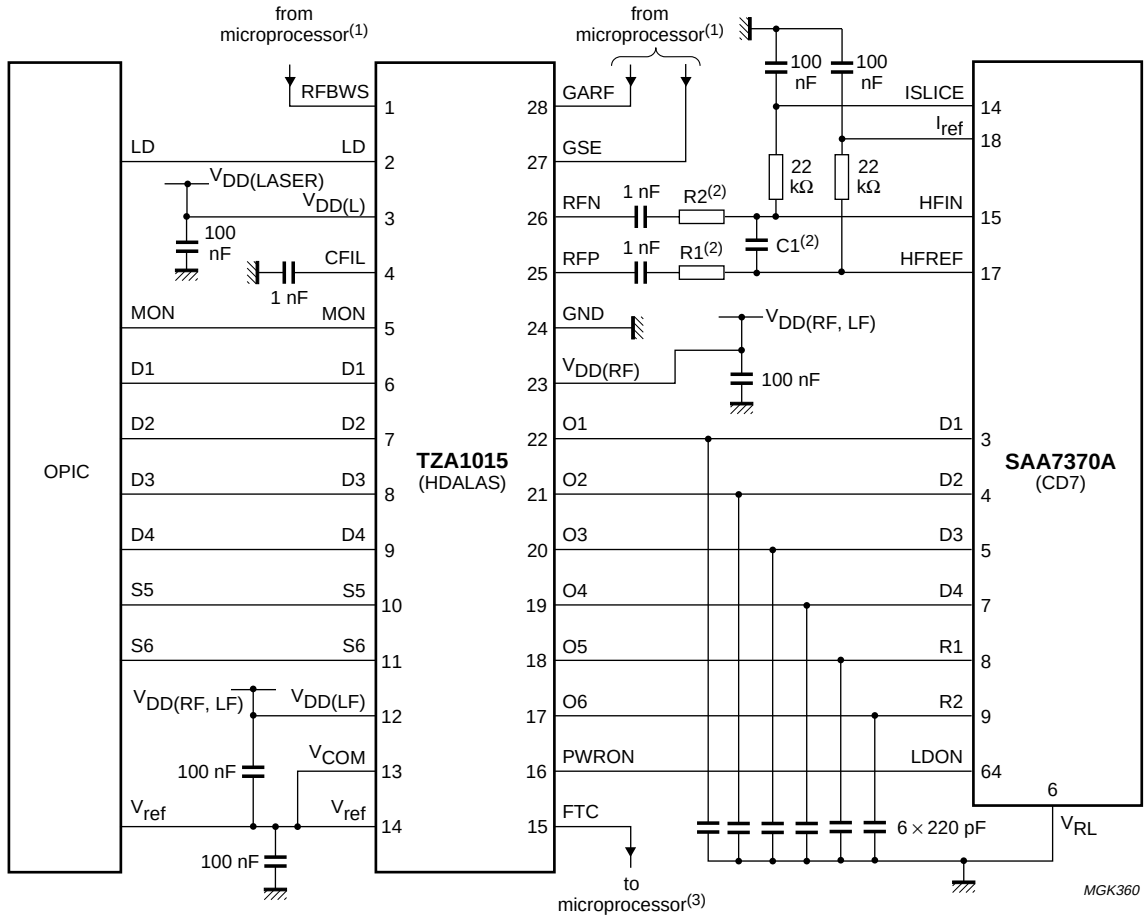
PIN GSE	PIN GARF	NOMINAL LF V/I CONVERSION (CENTRAL DIODES)	NOMINAL LF V/I CONVERSION (SATELLITE DIODES)	NOMINAL RF GAIN (dB)	NOMINAL FTC GAIN (dB)
LOW	LOW	47 kΩ	92 kΩ	7	14
LOW	open-circuit	47 kΩ	92 kΩ	10.5	18
LOW	HIGH	47 kΩ	92 kΩ	15	22
HIGH	LOW	12.5 kΩ	24.5 kΩ	19	24
HIGH	open-circuit	12.5 kΩ	24.5 kΩ	22.5	28
HIGH	HIGH	12.5 kΩ	24.5 kΩ	27	32

Table 2 Control inputs and RF bandwidth

PIN RFBWS	RF AMPLIFIER BANDWIDTH
LOW	10 MHz
open-circuit	20 MHz
HIGH	50 MHz

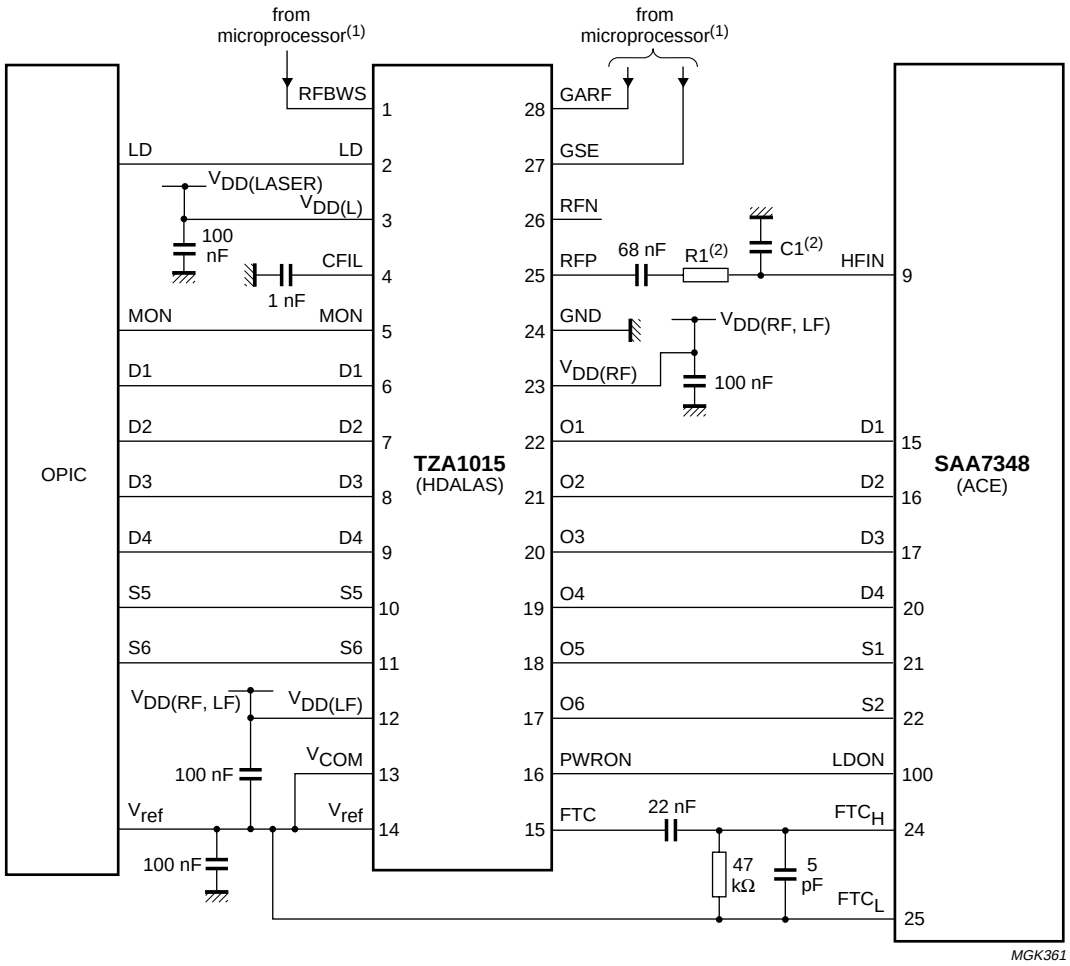
APPLICATION INFORMATION

The circuits shown in Figs 6 and 7 are applications for the TZA1015 (HDALAS) with the SAA7370A (CD7) or the SAA7348 (ACE).



(1) Pins RFBWS, GARF and GSE can be microprocessor controlled but can also be fixed or switched by any other means.
(2) For recommended values per speed see Table 3.
(3) The FTC output is available for optional processing.

Fig.6 Application diagram with SAA7370A (CD7).



(1) Pins RFBWS, GARF and GSE can be microprocessor controlled but can also be fixed or switched by any other means.
(2) For recommended values per speed see Table 4.

Fig.7 Application diagram with SAA7348 (ACE).

Table 3 Recommended values of components per speed for application diagram of Fig.6

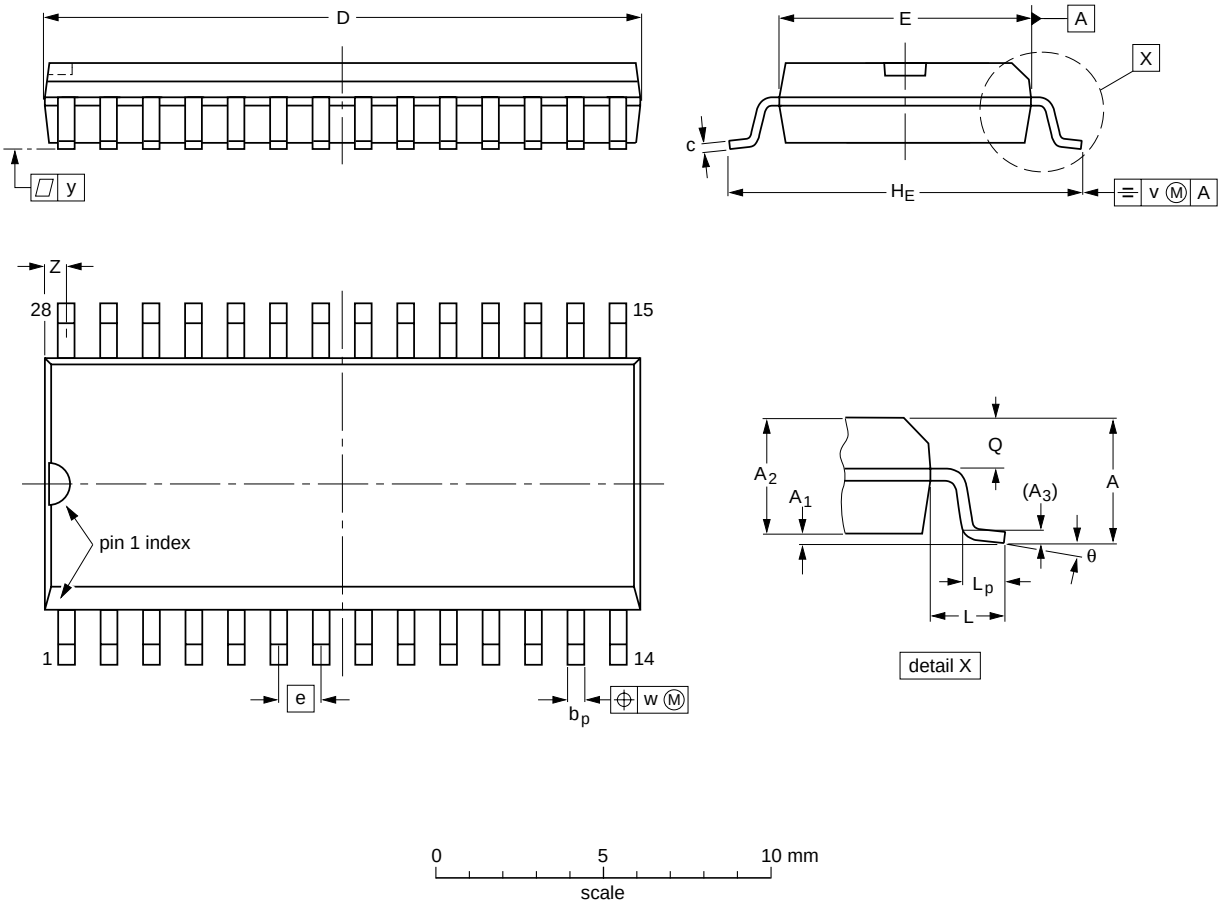
N	C1	R1	R2
1×	47 pF	1 kΩ	1 kΩ
2×	47 pF	470 Ω	470 Ω
4×	22 pF	470 Ω	470 Ω
8×	10 pF	470 Ω	470 Ω
10×	8.2 pF	470 Ω	470 Ω

Table 4 Recommended values of components per speed for application diagram of Fig.7

N	C1	R1
1×	100 pF	1 kΩ
2×	47 pF	1 kΩ
4×	22 pF	1 kΩ
8×	22 pF	470 Ω
16×	10 pF	470 Ω
18×	6.8 pF	470 Ω

PACKAGE OUTLINE

SO28: plastic small outline package; 28 leads; body width 7.5 mm **SOT136-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	18.1 17.7	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.71 0.69	0.30 0.29	0.050	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT136-1	075E06	MS-013AE				~~95-01-24~~ 97-05-22

SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (order code 9398 652 90011).

Reflow soldering

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

Wave soldering

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

Repairing soldered joints

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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